MST

Los Alamos
NATIONAL LABORATORY

Materials Science and Technology

MST

Materials
Science and
Technology

Materials Science and Technology Division

The Materials Science and Technology (MST) Division provides scientific and technical leadership in materials science and technology for the Los Alamos National Laboratory. We support a wide range of programs, including nuclear weapons stockpile stewardship, stockpile support, non-nuclear defense, energy, environment, industrial competitiveness, and strategic research. We integrate state-of-the-art capabilities in materials synthesis, fabrication, characterization, processing, and modeling to help solve technical problems critical to national and global security.

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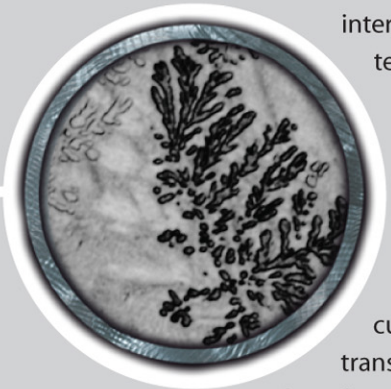
STC

Superconductivity Technology Center

The Superconductivity Technology Center (STC) coordinates a multidisciplinary program for research, development, and technology transfer in the area of high-temperature superconductivity. Our focus is on effective collaborations with American industry, universities, and other national laboratories to develop electric power and electronic device applications of high-temperature superconductors (HTS).



Outstanding scientific research projects underpin our international leadership position and provide the basis for technical advances. Applied research and development efforts include powder synthesis, tape/coil processing, thin/thick film deposition, characterization of microstructural and superconducting properties, power cryogenic engineering, and prototype devices. Current projects conducted in collaboration with industry include development of tapes, fault current limiters, magnetic separators, and power transmission cables based on HTS materials. New facilities have been established for continuous processing of coated conductor tapes at the Los Alamos Research Park and for electric power device development at the Atlas Building to enhance collaborations with American industry. Individuals from several Los Alamos organizations are a part of this team effort to evolve this exciting technology.

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NHMFL

National High Magnetic Field Laboratory

The National High Magnetic Field Laboratory (NHMFL) executes the NSF-funded pulsed magnetic field facility of the NHMFL under contract with Florida State University, as well as aligned DOE high magnetic field programs. The NHMFL catalyzes research in high magnetic fields, operates an international users program, develops synergistic programs with the LANSCE national user program for neutron scattering, and develops collaborations with the University of California in high magnetic field research.

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CINT

Center for Integrated Nanotechnologies

The Center for Integrated Nanotechnologies (CINT) is one of five Department of Energy/Office of Science Nanoscale Science Research Centers. Through its core facility in Albuquerque with gateways to both Los Alamos and Sandia national laboratories, CINT provides open access to tools and expertise needed to explore the continuum from scientific discovery to the integration of nanostructures into the micro and macro worlds.

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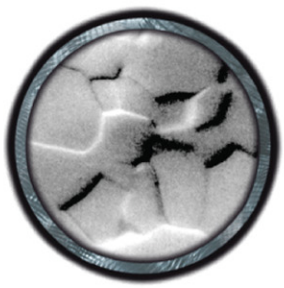
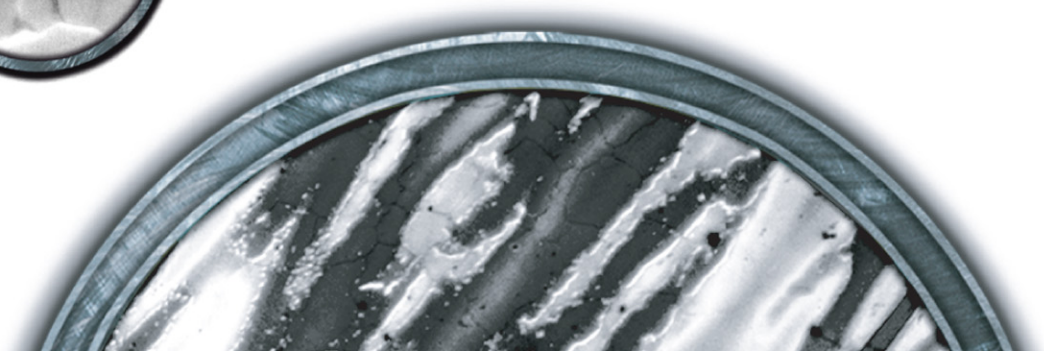
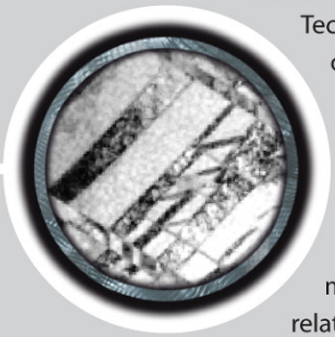




MST-6

Materials Technology: Metallurgy



The Materials Technology: Metallurgy Group (MST-6) focuses on materials science and engineering, emphasizing metallurgical processes and research. Activities range from delivery of high quality manufactured components to fundamental materials research. Technical focus centers on the fundamental understanding of manufacturing influences on materials performance, with an extension of this knowledge through models that can either predict performance outside existing testing experience or reverse-engineer performance bounds based on variance in processing parameters. This emphasis leads to in-depth characterization of the microstructure, composition, and performance metrics related to physical properties, homogeneity, or structural response. To accomplish this mission, we manage an extensive materials fabrication and characterization capability. Our competence spans alloy design and development, foundry and solidification, powder metallurgy, mechanical metallurgy, welding and joining, electrochemical processing, corrosion, microstructural and mechanical characterization, and manufacturing systems to comply with full weapons production and quality rigor. These extensive capabilities make this group the only metallurgical consortium of its kind in the world. Our uniqueness comes not only from our breadth of competence, but also our ability to perform complete uranium and beryllium manufacturing within a secure environment compliant with DOE classification regulations and applicable health and safety standards. We have multi-customer support from conventional munitions, industrial applications, university consortia, and basic research with a strong foundation in the nuclear defense sector.

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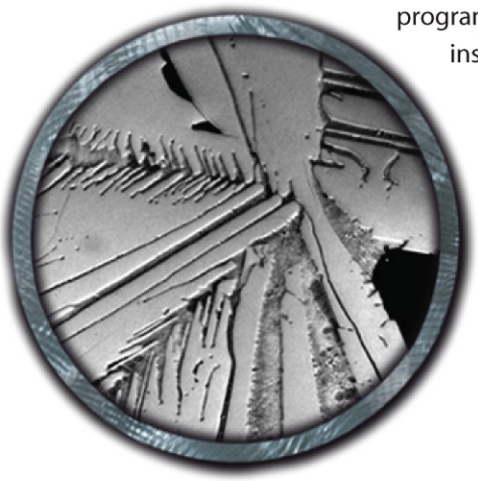
MST-7

Polymers and Coatings

The Polymers and Coatings Group (MST-7) is engaged in areas of materials science from the fundamental to the applied. The group comprises the Laboratory's expertise in polymer sciences, chemical vapor deposition, physical vapor deposition, micro-machining (including diamond turning), precision manufacturing and assembly, and fabrication of experimental packages for the Inertial Confinement Fusion and Radiation Physics (ICF&RP), the High Energy Density Hydrodynamics (HEDH), and other elements of the nuclear weapons programs. In addition, we operate the Laboratory's glass shop as an institutional service. We maintain a broad program base including energy, nuclear weapons, conventional defense, industrial collaborations, nonproliferation, and environment.



Our program base is founded in materials synthesis, processing, patterning, and characterization. Some major efforts are the following: the elucidation of the mechanisms of polymer aging and degradation; fundamental structure/property relationships of thermoplastic elastomers, polymer foams (including filled hybrid organic-inorganic systems); high energy density materials; target fabrication development and technology; three dimensional noncontact metrology development; laser-induced synthesis of superhard materials in thin film and fiber form; chemical vapor deposition of oxide, nitride, and diamond coatings; chemical vapor infiltration; preparation of oriented films and multilayer coatings; sensors; membranes for separations; and the advancement of nanotechnology. We also have an extensive set of chemical and physical characterization capabilities. In collaboration with MST-6, we use scanning electron microscopy and metallography to examine tritium-contaminated materials of interest to the nuclear weapons program and other programs.

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MST-8

Structure/Property Relations

The Structure/Property Relations Group (MST-8) provides a laboratory focus on expertise and facilities used to evaluate and understand the relationships between material properties and their underlying structures. The represented capabilities reflect both a broad suite of state-of-the-art material structure and property evaluation methods, as well as a number of specialized facilities to carry out materials research in support of laboratory programmatic missions. We are responsible for providing institution-wide electron microscopy, ion microprobe, and ion implantation facilities. The group also possesses expertise in x-ray and neutron scattering, synchrotron x-ray studies, and scanning probe microscopies. Specific focus areas include materials mechanics, dynamic materials properties, ion/solid interactions and interface engineering, metastable and amorphous materials, multilayers, computational materials science, single crystal synthesis, high-temperature structural materials, radiation tolerant ceramics, and optically functional materials.

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MST-10

Condensed Matter and Thermal Physics

The Condensed Matter and Thermal Physics Group (MST-10) emphasizes fundamental research on condensed matter. We have several complementary thrusts: synthesizing, characterizing, and understanding the physics of complex materials, particularly those with novel superconducting and magnetic behavior and/or emergent properties with exploitable functionalities; developing novel materials characterization capabilities, especially those with nanoscale spatial and/or temporal resolution, and applying them to industrial, security, and energy-related technologies; investigating fluid dynamics/thermodynamics in non-linear science and refrigeration; and exploiting ultrafast laser techniques to understand dynamical processes in a wide range of systems. Many of these activities require our expertise in cryogenic and high-pressure environments and involve collaborations with universities, industry, and other laboratories around the world, as well as throughout Los Alamos.

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The images seen throughout this brochure are the result of microstructural characterization, a series of techniques used by materials scientists to study the inter-relationships between processing, structure, and properties of materials. In MST Division, our studies cover the periodic table from specific elements to a wide range of alloys and composites in our quest to discover these key relationships. Using a variety of capabilities and equipment, including electron, scanning probe, and optical microscopies, researchers characterize macro-size shapes and features of materials; micro/nano-size structures such as grains and particles; and elemental distributions within materials.

Images provided by the Materials Technology: Metallurgy Group.

MST-11

Electronic and Electrochemical Materials and Devices

The Electronic and Electrochemical Materials and Devices Group (MST-11) conducts basic and applied research on electrically and ionically conducting materials, including the development of novel materials characterization approaches. Our research forms a basis for development in device technology and practical application of materials. Our major projects include research on polymer electrolyte fuel cells and related conducting polymer electrochemical devices, fundamental research on catalysis, electrochemical sensor technology for chemical and biochemical detection, electrochemical applications of high temperature ceramics, acoustic nondestructive testing for chemical and biological agent detection, basic and applied work on organic electronics and electroluminescent polymers, and research on spintronics devices. We support a suite of capabilities in materials and device development and characterization, including a clean room for device fabrication, which we use extensively in multiple collaborations with industry.

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National Nuclear Security Administration

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